

AMENDMENTS TO THE DRAWINGS

The attached 11 sheets of replacement drawings include the changes noted herein. No new matter is added.

FIG. 1 – handwritten text replaced with typed text

FIG. 2 – handwritten text replaced with typed text

FIG. 4 – handwritten text replaced with typed text

FIG. 6a – handwritten text replaced with typed text ; label “Light-Coupling Pattern (Post-type) 60” has been amended to “Light-Coupling Pattern (Post-type) 70” to more clearly distinguish the post type grating from the waffle type grating.

FIG. 6b – handwritten text replaced with typed text; label “Light-Coupling Pattern (Waffle-type) 60” has been amended to “Light-Coupling Pattern (Waffle-type) 80” to more clearly distinguish the post-type grating from the waffle-type grating.

FIG. 7a – label “Posts or Holes” has been amended to “Posts 62 or Wells 66” to more clearly distinguish the post-type grating from the waffle-type grating; the label “Pixel 90” has been added to note that that structure is a pixel.

FIG.s 8a to 8d – cleaner presentation of figures

FIG. 9 – enlarged the presented figure

FIG. 10 – enlarged the presented figure

FIG. 11a – cleaner presentation of figure

FIG. 11b – enlarged the presented figure

REMARKS

Drawings

The Office objected to the filed drawings as being informal. A set of substitute drawings are submitted herein for replacement with noted changes to more clearly illustrate the claimed invention. The replacement sheets have removed hand-written text and include cleaner figures and enlarged presentations as noted herein. No new matter is added.

In more particular detail, Applicant has amended Figure 6a to denote the post-type grating as element 70 and the waffle-type grating of Figure 6b is denoted as element 80. Figure 7a has been amended to include a reference label for "Pixel 90" to note that the structure is a pixel. This aids in understanding the orientation of the grating 60 on the pixel 90, wherein the grating is oriented to the edges of the pixel 90. Reference number "60", "62", "66" has been added to more clearly identify the "Light-Coupling Grating Pattern 60" and the "Posts 62" and "Wells 66". The term "Holes" has been amended to "Wells" to more clearly identify the well structures. This is for clarification purposes and corresponding changes to the specification are included herein.

Claims Rejections - 35 USC §112 Second Paragraph

The Office rejected Claims 1 – 20 under 35 USC 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the applicant regards as the invention. A §112 second paragraph rejection has two separate requirements, indefiniteness and failing to claim what applicant regards as the invention. With respect to indefiniteness, the "essential inquiry pertaining to this requirement is whether the claims set out and circumscribe a particular subject matter with a reasonable degree of clarity and particularity. Definiteness of claim language must be analyzed, not in a vacuum, but in light of (1) the content of the particular disclosure, (2) the teachings of the prior art, and (3) the claim

interpretation that would be given by one possessing the ordinary level of skill in the pertinent art at the time the invention was made." (MPEP §2173.02).

A rejection stating that the claims fail to set forth the subject matter that the applicant regards as the invention is only appropriate where the applicant has stated that the invention is something different from what is defined by the claims (MPEP §2172(a)). There is a presumption that the claims describe the applicant's invention, absent evidence to the contrary.

In more particular detail, the Office has rejected the claims and states that "[t]here is no standard "waffle" configuration and it is unclear what type of "waffle" structure" is covered by the claims. The Office's focus during examination for compliance the requirement for definiteness of 112 (second paragraph) is whether the claim meets the threshold requirements of clarity and precision - not whether more suitable language or modes of expression are available. The essential inquiry pertaining to a rejection under 112 (second paragraph) is whether the claims set out and circumscribe a particular subject matter with a reasonable degree of clarity and particularity. MPEP 2173.02. This is an objective standard because it is not dependent on the views of applicant or any particular individual, but is evaluated in the context of whether the claim is definite – i.e., whether the scope of the claim is clear to a hypothetical person possessing the ordinary level of skill in the pertinent part. MPEP 2171. In other words, 112 (second paragraph) generally requires that the "claims, read in light of the specifications, reasonably apprise those skilled in the art.

Applicant believes that the specification and drawings clearly illustrate a waffle configuration, wherein the structure resembles a waffle having wells instead of posts. For illustrative purposes, Applicant directs the Office to Figures 6a and 6b of the present application which are presented herein. Figure 6a shows a number of posts while Figure 6b shows a waffle configuration with wells etched out, leaving the grid lines in relief to form the sidewalls of the wells and the lower level forming the floor.

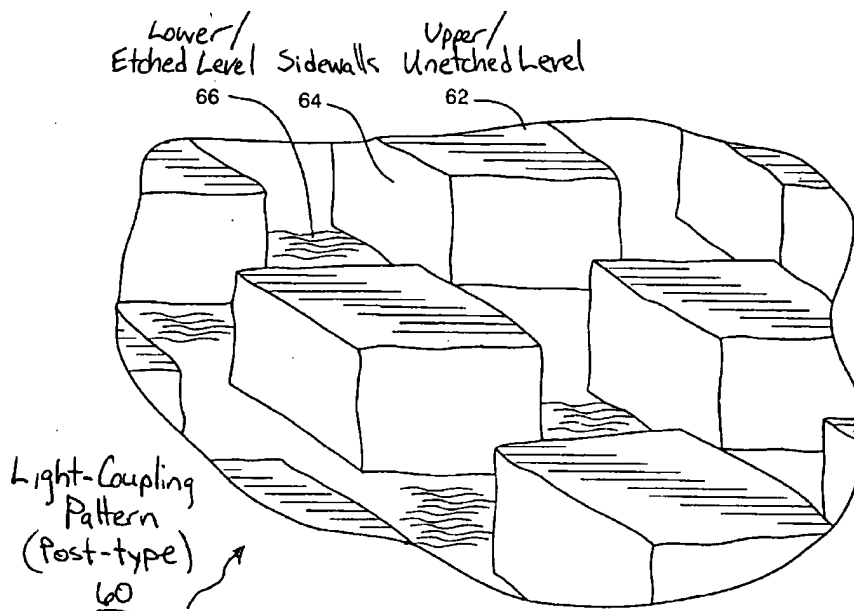


FIG. 6a

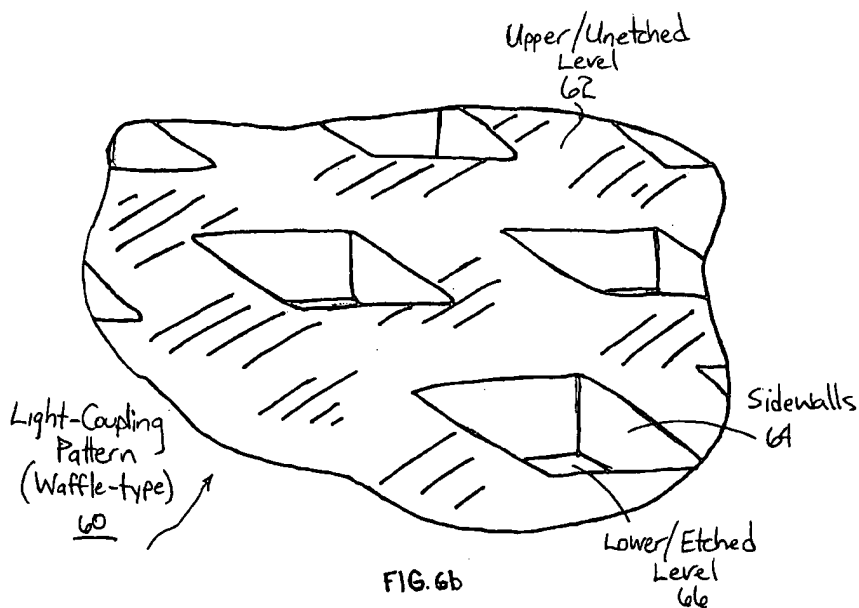


FIG. 6b

Certain post type patterns are known in the art, and the post configurations start with an upper level surface and etch the surface grid lines to leave posts. In essence, a waffle configuration has wells etched out from the upper level whereas post gratings etch around the

posts to leave the posts. For clarification purposes, the claims have been amended to match the specification description with respect to 'wells' in stead of 'holes', as the wells of the present invention have sidewalls (Fig. 6b – 64) and a lower level (Fig. 6b - 66)

A pixel is a complicated three dimensional cavity with respect to electromagnetic waves. For example, taking a frame of reference of an electromagnetic wave in the well or cavity of the waffle configuration, the light (electromagnetic waves) enters from the backside as shown in Figure 2. Looking at the waffle grating surface from inside the pixel, the electromagnetic waves 'see' a periodic array of reflector islands (Fig. 6b - lower level 66) closer to the quantum wells and the reflector grid (Fig. 6b - upper level 62) further away from the quantum wells.

In distinction to the post configuration, the electromagnetic waves first encounter the reflector grid (Fig. 6a - lower level) which is closer to the quantum wells than the reflector islands (Fig. 6a – upper level).

The surprising result, which was empirically derived, and shown in the measurement of Fig 8a-8d, is the superior response of the waffle grating as compared to the post configuration. The models that tried to simulate the waffle structure using Maxwell's equation and complex processing was inconclusive. Thus, the inventors built the structures for the test data collected in Figures 8a – 8d and experimented with the orientations as noted in those graphs. As noted, there is a significant increase in the quantum efficiency with an improved conversion efficiency. The waffle grating thus improves the light absorption by the quantum wells with respect to the post grating. Further improvements are obtained by rotating the waffle grating.

Therefore, while the Office argues that the structures are not structurally distinguished, Applicant respectfully disagrees. The waffle grating structures are different than the post grating structures as described in the application. And, the Applicant refers the Office to Figure 8a to 8d of the present application which compares post and waffle grating performance. The waffle-type grating has superior performance as compared to the post-type grating demonstrating that the

structures are different. The improvement appears to be related to the waffle grating structure causing the electromagnetic waves to better couple to the quantum wells.

The Office also finds the orientation relationships to lack a point of reference. As explained in the application and illustrated in Figures 7a - 7f, the pattern of the grating 60 is oriented to the "major edges of the pixel." The pixels of Figure 7a - 7f are shown as being approximately square or rectangular and the various grating patterns for 0 degrees and 45 degrees with respect to the major edges of the pixel for different arrays are depicted. As known in the art, the orientation is with respect to the edges of the pixel, for example the edges establishing 90 degree x and y axes. The claims have been amended to clarify this aspect.

The claims have been amended to clarify these distinctions and for at least the reasons provided, the rejection is traversed.

Claims Rejections - 35 USC §102(b)

The Office rejected claims 1 -20 under 35 U.S.C. 102(b) as being anticipated by the cited references, namely "Quantum Well Infrared Photodetector (QWIP) Focal Plane Arrays"; "Tridirectional Gratings as Improved Couplers for QWIPs"; and "Metal Side Reflectors for Trapping Light in QWIPs". A rejection based on anticipation requires that a single reference teach every element of the claim (MPEP § 2131). "The identical invention must be shown in as complete detail as is contained in the ... claim." *Richardson v. Suzuki Motor Co.*, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989) Or stated in another way, a "claim is anticipated only if each and every element as set forth in the claim is found, . . . described in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). . . .

The Office rejected these claims based on the description on pages 42-44 of "Quantum Well Infrared Photodetector (QWIP) Focal Plane Arrays" which refers to two-dimensional

grating and corrugated structures. The basis for the rejection resulted primarily because the Office did not consider the attributes of “waffle” and “orientation.”

In more particular detail, the corrugated structures refer to a pixel having a corrugated surface such as shown in Figure 27(a) and 27(b). It is visually apparent that the corrugated layer used for the grating does not resemble in any manner the grating of the present invention. In fact, the corrugated grating resembles corrugated roofing having a plurality of angled facets. This grating is not similar in form or function as to the present invention.

The two-dimensional grating described on page 42 refers to the etching processing creating posts having “groove depths” and the reference to grating mask for the photolithographic processing. The etching processes to create an optical grating of posts are acknowledged. However, there is no description of a waffle-type grating formed from etching wells.

Figures 6a and 6b of the present application more clearly depict the differences between a post-type grating and a waffle-type grating as indicated herein. The claims have been amended to more clearly indicate the waffle-type structure.

A further rejection is based on the orientation aspects of the claims wherein the grating can be oriented with respect to the pixel as shown in Figures 7a – 7f. For example, a square pixel having 30 micron sides can have a waffle-type grating on the top layer with the grating shifted in relation to the sides of the pixel. The array of wells of the waffle-type grating can be shifted with respect to the sides of the pixel. The claims have been amended to indicate that the orientation is with respect to the major sides of the pixel.

With respect to the rejection based on “Tridirectional Gratings as Improved Couplers for QWIPs”, the Office refers to the “metal hole structure” described therein. This article depicts metal diffraction gratings having a hexagonal pattern. The description is very brief, but describes metal diffraction gratings formed in the cap layer of the QWIP.

As is well-known, a grating is an optical device consisting of a periodic pattern of grooves, channels or cavities, wherein a diffraction grating is used to diffract electromagnetic radiation. During diffraction the propagation angle of the radiation (compared with the incident radiation) will change. The diffraction angle changes with wavelength, and if the periodic pattern is in one direction only the grating is a linear grating, if the periodicity is in two (usually orthogonal) directions, it is a two-dimensional grating.

The diffraction gratings are typically metal films with a periodic array of wells. In most cases, approximately half of the light is diffracted into reflection and the other half is diffracted into transmission. While a QWIP pixel can use such a grating arrangement, about half of the signal would be lost. QWIPs typically use a full reflection grating so as to get most/all of the light diffracted back into reflection. The waffle grating of the present invention is created by having a periodic variation in the height of the metal and not by having holes in the metal. A periodic variation in any property of the metal film causes diffraction and the present invention does not employ holes.

As shown in the figure of the article, the diffraction grating is either a plurality of hexagonal holes or patches – it is not a waffle structure having the elemental structure shown in Figure 6b of the present application.

The article entitled “Metal Side Reflectors for Trapping Light in QWIPs” describes certain aspects of metallized side reflectors for trapping light. This brief article provides vague references to metal side reflectors and gold coating the sides of the QWIPs, however there is reference to etching wells and establishing a waffle configuration.

The claims have been amended to more clearly identify the present invention, and for at least the reasons presented herein, reconsideration and allowance is requested.

Claim Rejections – 35 USC § 103

The Office has quoted the statute from 35 USC 103(a), which is referenced herein. The Office has rejected claim 1 – 20 as being unpatentable over “Quantum Well Infrared Photodetector (QWIP) Focal Plane Arrays”; “Tridirectional Gratings as Improved Couplers for QWIPs”; and “Metal Side Reflectors for Trapping Light in QWIPs”. Furthermore, claims 1-20 are rejected as being unpatentable over “Quantum Well Infrared Photodetector (QWIP) Focal Plane Arrays” in view of “Fabrication of 2-D Photonic Bandgap Structures in GaAs/AlGaAs” or Scherer (Published Pat. Appl. No. U.S. 2002/0167984). Applicant does not concede all these to be prior art references. However, Applicant has carefully considered the Office rejections and respectfully submits that the amended claims, as supported by the arguments herein, are distinguishable from the cited reference.

According to the MPEP §2143.01, “[o]bviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found in either the references themselves or in the knowledge generally available to one of ordinary skill in the art.”

A useful presentation for the proper standard for determining obviousness under 35 USC §103(a) can be illustrated as follows:

1. Determining the scope and contents of the prior art;
2. Ascertaining the differences between the prior art and the claims at issue;
3. Resolving the level of ordinary skill in the pertinent art; and
4. Considering objective evidence present in the application indicating obviousness or unobviousness.

Therefore, obviousness cannot be established by combining prior art references to produce the claimed invention absent some teaching or suggestion supporting the combination. The mere fact that the prior art may be modified in some manner suggested by an examiner upon review of the claims of the present application does not make the modification obvious, unless the prior art suggested the desirability of the modification.

The Board of Patent Appeals and Interferences (BPAI) continues to reverse Examiners that can not explain “why a person of ordinary skill in the art would have found it obvious” to combine the references in the manner proposed by the Examiner.” Furthermore, the Applicant notes that none of the references specifically recognized the advantages discussed in the present application.

As described herein, most of the cited references have already been addressed and the amended claims should be in form for allowance.

“Quantum Well Infrared Photodetector (QWIP) Focal Plane Arrays” in view of “Fabrication of 2-D Photonic Bandgap Structures in GaAs/AlGaAs” or Scherer (Published Pat. Appl. No. U.S. 2002/0167984).

These Photonic Band Gap structures described in “Fabrication of 2-D Photonic Bandgap Structures in GaAs/AlGaAs” cause a periodic change in refraction and generate a band gap. This brief reference seems to describe the formation of certain patterns resembling the post formation already acknowledged. It does not describe the amended claim elements.

Scherer describes a compact electrically and optically pumped multi-wavelength nanocavity laser. There are modulator and detector arrays to define the precise spectral response of each element with high fields applied within optical nanocavities to take advantage of photonic crystals filled with nonlinear materials. These nonlinearities and high fields are used to define tunable nanocavity lasers, detectors, routers, gates and spectrometers for wavelength and time division multiplexing applications. The Applicant fails to see the significance of this reference and if the Office maintains a rejection based on Scherer, clarification is requested.

If the Office maintains any further rejection, Applicant respectfully requests that the individual rejected claims include detailed description of the rejection and the specific reference,

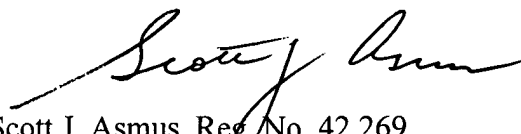
preferably with page/paragraph number, in order for the Applicant to more focus on the rejections.

Telephone Interview

Present Office policy places great emphasis on telephone interviews initiated by the examiner. For this reason, it is not necessary for an attorney to request a telephone interview. Examiners are not required to note or acknowledge requests for telephone calls or state reasons why such proposed telephone interviews would not be considered effective to advance prosecution. However, it is desirable for an attorney to call the examiner if the attorney feels the call will be beneficial to advance prosecution of the application. MPEP§408

Applicant believes the above amendments and remarks to be fully responsive to the Office Action, thereby placing this application in condition for allowance. No new matter is added. Applicant requests speedy reconsideration, and further requests that Examiner contact its attorney by telephone, facsimile, or email for quickest resolution, if there are any remaining issues.

Respectfully submitted,



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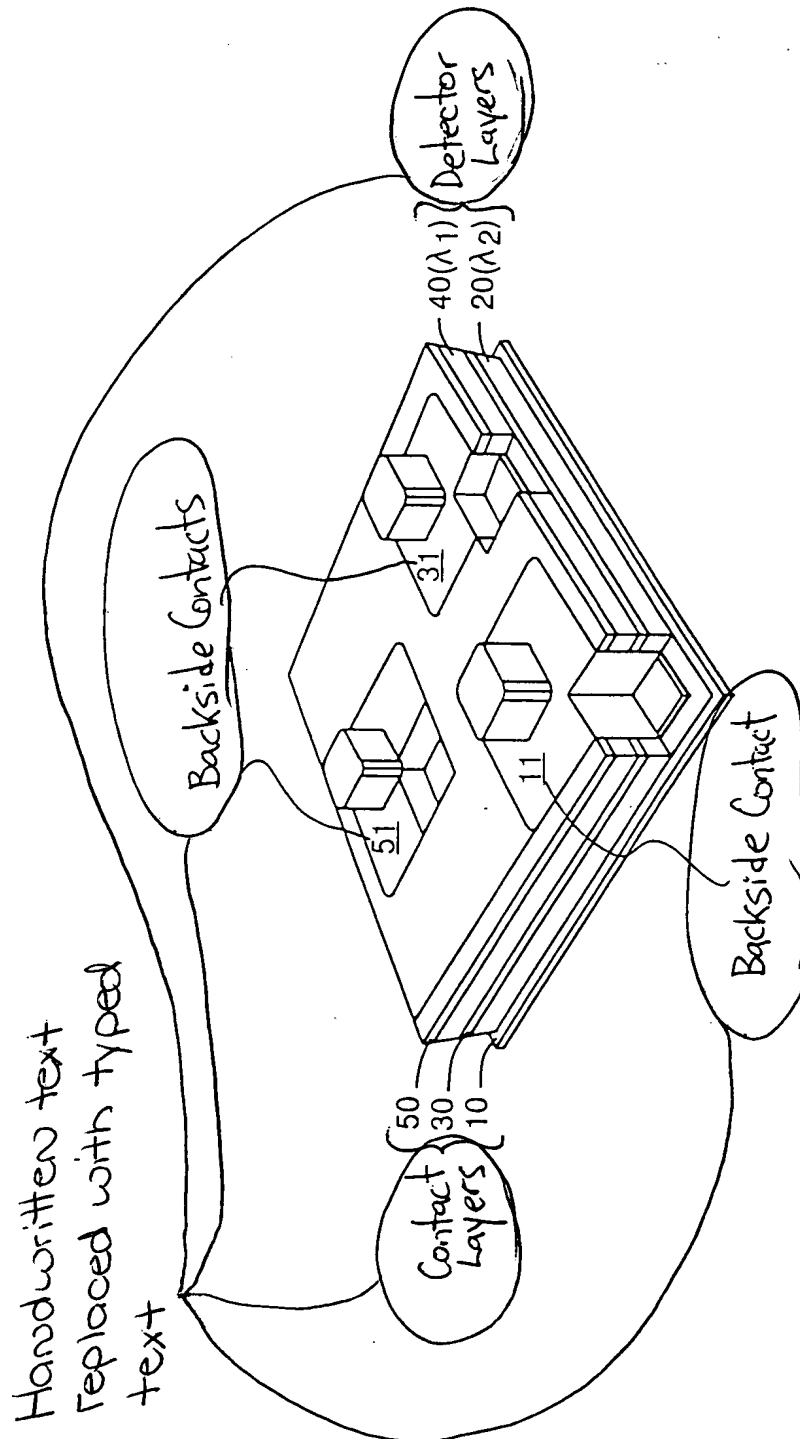


FIG. 1

ANNOTATED SHEET SHOWING CHANGES

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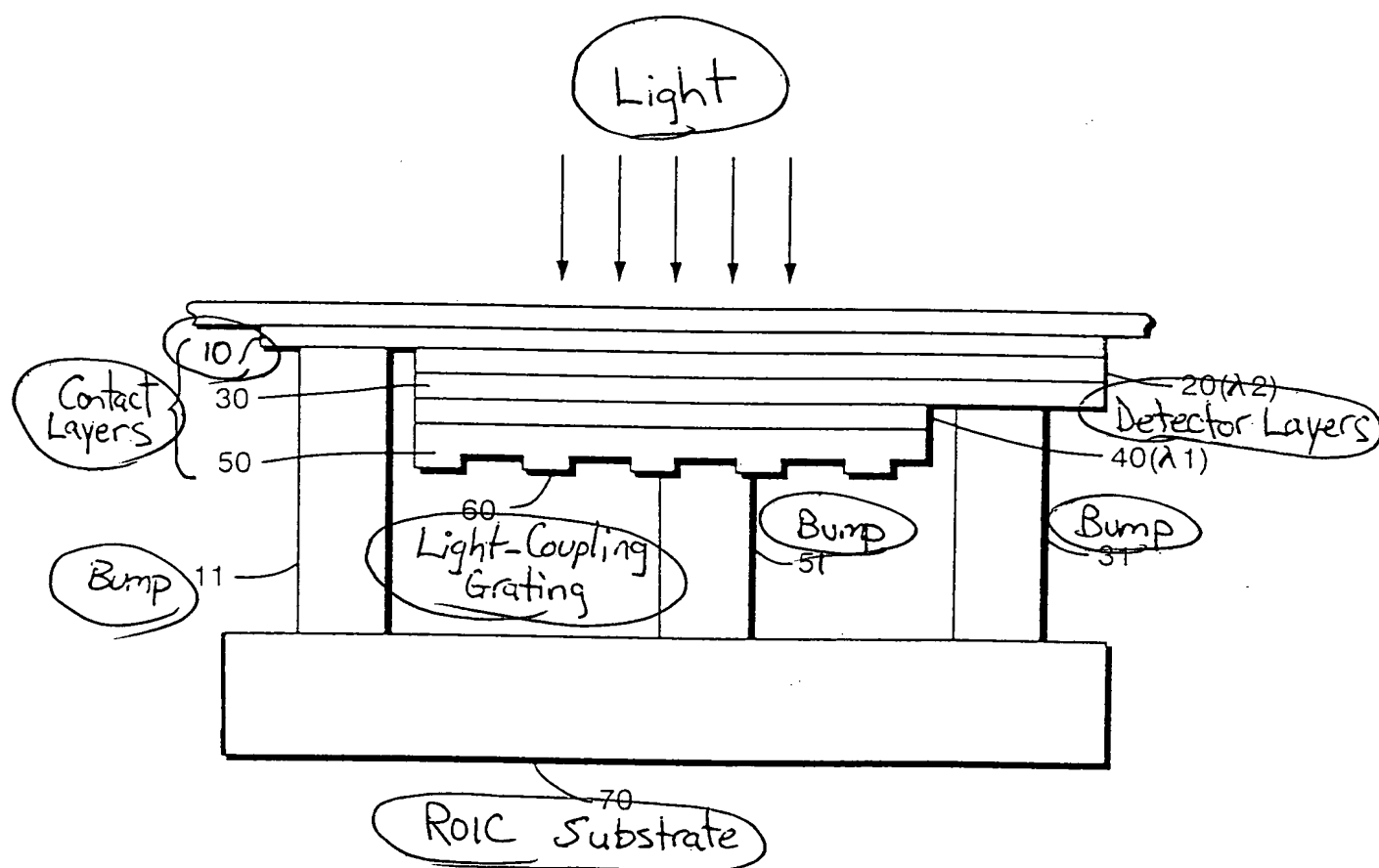


FIG. 2

Handwritten text replaced
with typed text

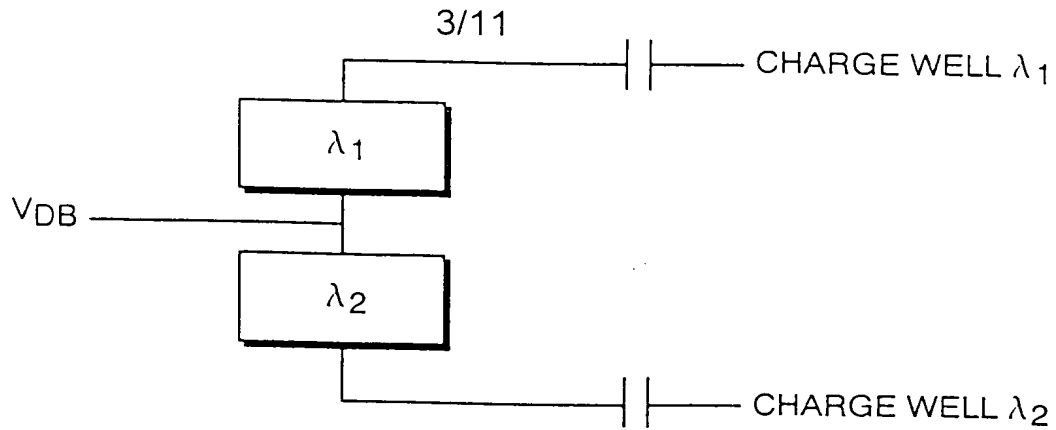


FIG. 3

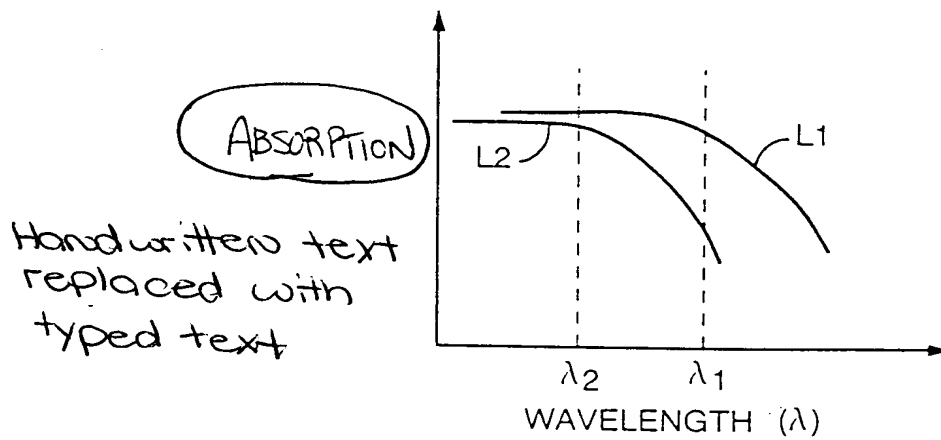


FIG. 4

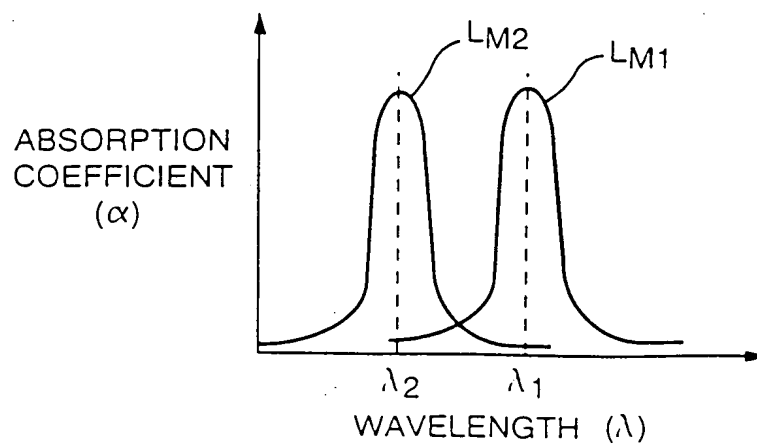
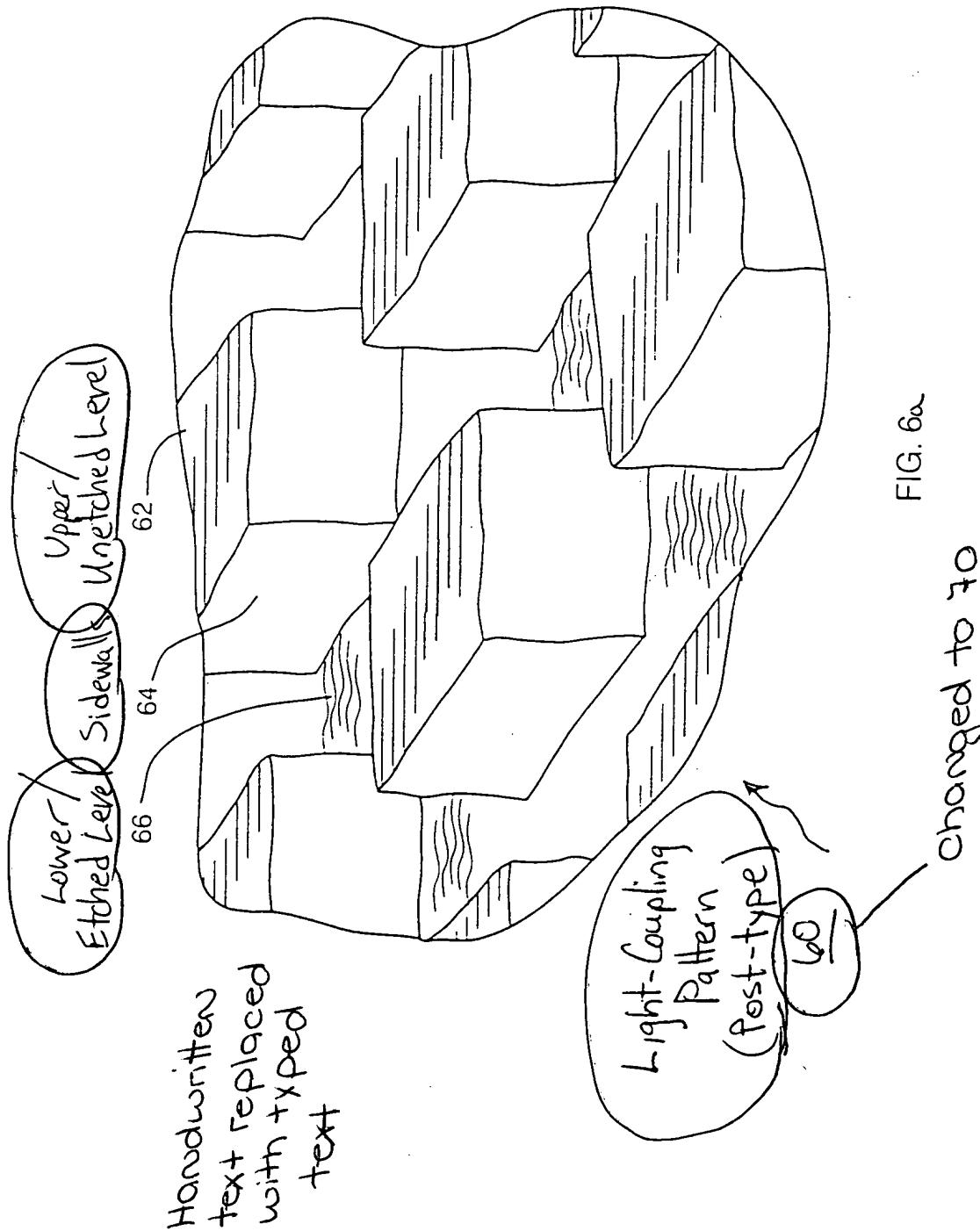
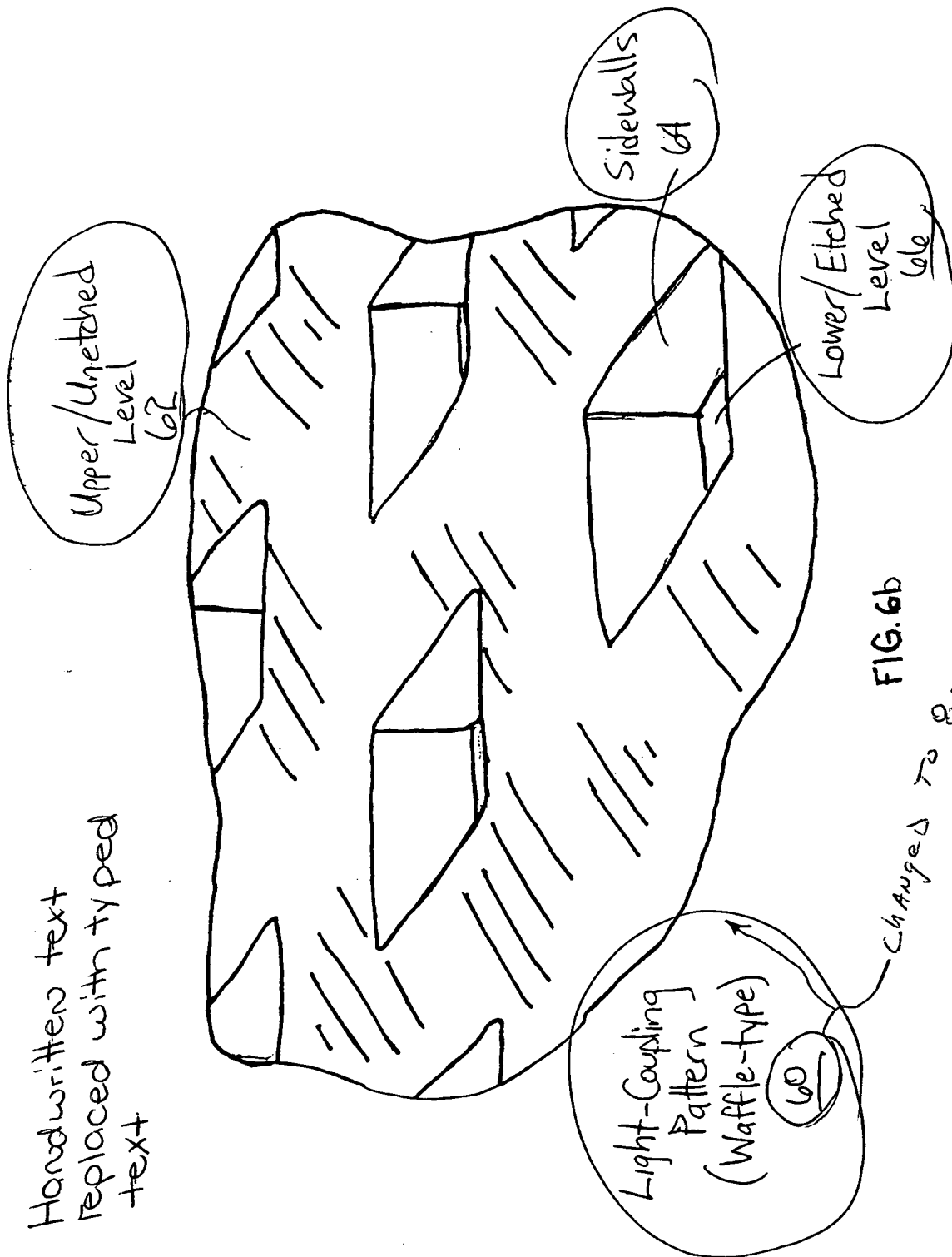


FIG. 5

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Light-Coupling Grating Pattern **60** Add
 Changed Posts or Holes to **62** OR **66** wells **66**
 Add **Pixel 90**

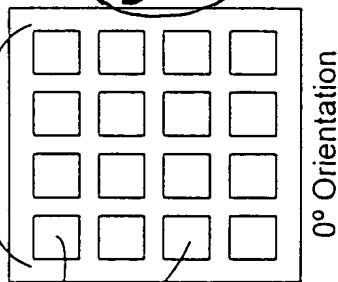


FIG. 7a

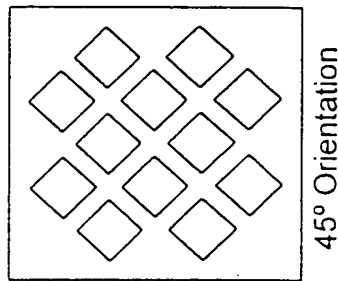


FIG. 7b

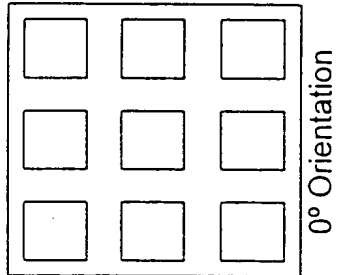


FIG. 7c

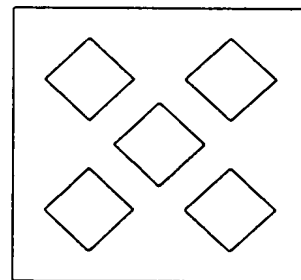


FIG. 7d

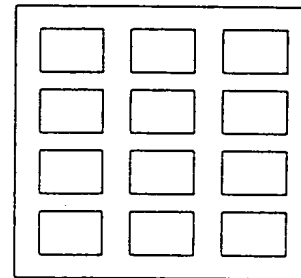


FIG. 7e

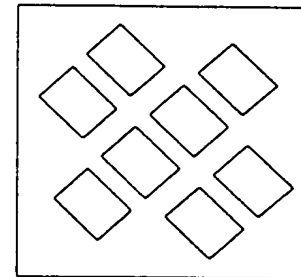


FIG. 7f